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ABSTRACT

The major purpose of this study was to identify effective methods or procedures that high school biology teachers would recommend to help their students master the skills needed for reading and understanding their biology textbooks, workbooks, laboratory manuals, and other printed materials used in biology classes. It was hypothesized that well-educated, experienced science teachers who had done graduate work in biology or methods of teaching science in high school and who had also been involved whether in courses dealing with teaching reading in content areas or in-service training dealing with study skills and reading in science could suggest specific practices that would be worthy of recommendation to other high school biology teachers (grades 9-12). The procedure in this study involved the following: (1) a review of the research on general reading and study skills in the content areas of the secondary school; (2) extensive use of the ERIC system; and (3) interviews with the 71 teachers who met the criteria and who were interested in taking part in the study. The data secured from the interviews indicated essentially the 10 most effective ways for helping students learn the special reading and study skills needed in high school biology classes. (KR)

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# SELECTED HIGH SCHOOL BIOLOGY TEACHERS' RECOMMENDATIONS FOR TEACHING READING AND STUDY SKILLS NEEDED IN BIOLOGY CLASSES

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The major purpose of this study was to identify effective methods or procedures that high school biology teachers would recommend to help their students master the skills needed for reading and understanding their biology textbooks, workbooks, laboratory manuals and other printed materials used in biology classes. This researcher hypothesized that well-educated, experienced science teachers who had done graduate work in biology or methods of teaching science in high school and who had also been involved either in courses dealing with teaching reading in content areas or in in-service training dealing with study skills and reading in science could suggest specific practices which would be worthy of recommendation to other high school biology teachers (grades 9-12).

## Perspectives

In most modern secondary school classrooms teachers have to be concerned with teaching reading and study skills as well as the content in their field or fields. Yet it is still true that most school systems rely on the elementary school teachers to teach reading and study skills. Such instructional programs generally place emphasis on the reading of narrative or simple factual material and are usually terminated at the end of the fifth or sixth grade. Beyond the elementary and junior high school level, instruction in reading and study skills is mostly

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optional and dependent upon the individual teacher's recognition of his/her students' needs.[1] For that and other reasons there are many students in high school biology classes who have had little, if any, instruction in the reading and study skills needed for effective learning in biology.

Many reading specialists estimate that in ninth and tenth grade biology classes where I.Q.'s often range from 85 to 130 and where the average age is 16 years or more, there will probably be eight grade levels of reading ability represented in those classes.[2] Many times the teacher is confronted with the task of teaching these students with only one textbook and a laboratory manual or workbook. Thus, since most learning in secondary school classes is through the use of textbooks, reading and study skills become the "common denominator" of learning in such classrooms.[3] Yager and Penick point out that many high school students have difficulty--not necessarily because they are unable to read--but because they do not have the reading and study skills essential for reading and learning effectively in major content areas.[4]

This article is a report on a study which was conducted during the time between December, 1989, and December, 1991, by the author with the help of teachers in California (8), Maryland (7), North Carolina (15), Oklahoma (9), South Carolina (7), Texas (21), and Virginia (4). The study was limited to these 71 biology teachers who taught in high schools with enrollments ranging from 500 plus to 2,000 plus. All of the science teachers studied had taught biology classes at least four years. Over

one-half of them--56--had completed 21 hours or more of graduate work in biology or science education. Eleven had a master's degree in education with some work in science. Four had a master's degree in biology.

The procedures in this study involved the following: a review by the author of the research on general reading and study skills in the content areas of the secondary school; extensive use of the ERIC system; and interviews with the 71 teachers who met the criteria stated above and who were interested in taking part in the study. A carefully designed questionnaire was used in all of the interviews. Thirty-two interviews were conducted by the author himself. The others were conducted by persons who held a doctorate in reading and who had also taught science courses in public or private schools.

## Some Recent Related Literature

An intense review of the literature dealing with the specific reading and study skills needed by students in secondary school biology was conducted.

Since this study was concerned primarily with the methods and practices of the 71 selected teachers being studied, only a very brief summary of some of the more pertinent research on the topic of reading and study skills needed in high school biology classes will be presented here.

As was mentioned above, in many recent studies the point is made that in a majority of school systems most students still experience only basal reading instruction. Often the instruction

in elementary school training in how to read and study in the content areas is dependent upon the individual teacher's recognition of students' needs, group reading tests and the teacher's ability and willingness to meet those needs.[5] Many educators state that the student's reading ability will ultimately be the crucial factor in his/her success or failure in science classes such as biology. Every teacher in every high school biology classroom is dealing with materials the student must read and study. This means that the teacher will have many opportunities to help students who are reading the required printed materials in the course.[6]

In the past many high school biology teachers--and science teachers in general--felt either unable to help students in the area of reading and study skills or that it was not their responsibility. This is one of the major reasons some school systems try to provide in-service help in this important area. Fortunately, many biology teachers now believe that they can and should help their students with the reading and study skills needed in their classes. They still feel that although their primary responsibility is the teaching of biology, they must help with reading and study skills so that their students can learn more effectively. In other words, instruction in reading and study skills has become an integral part of teaching.[7] Many states now specify that not only must undergraduate students in elementary education have course work in teaching reading but also that future secondary school teachers must have some work dealing with the teaching of reading as well as teaching the content of high school classes such as biology.[8]

Rubin believes that even proficiency in general reading skills is not enough for success in biology classes. She pointed out in a recent textbook that students need a specialized vocabulary and special study skills in each of the content areas.[9] Many reading specialists and experienced high school teachers--in science and other content areas--assert that to teach content effectively, teachers must be aware of the varying needs and abilities of their students and provide professional help in the reading and study skills which are demanded by the content.[10]

Alvermann and Moore state that with few exceptions the content teacher--science teacher in this case--is the best qualified individual for giving instruction in high school classes. They feel this is true because through the teacher's interest, preparation, and education, each is a specialist in his/her field. It is usually the biology teacher who has acquired the background in vocabulary, concepts, and generalizations which is necessary for intelligent instruction in this area. The biology teacher should be the most capable to help students learn to pronounce new words, to understand new concepts, to determine the crucial parts of material which require slow, thoughtful reading and those areas which need only skimming or rapid reading.[11]

The major research studies dealing with the teaching of reading and study skills in science published in the past ten years clearly set forth many promising strategies for improving the reading and study skills of students in high school science classes. Most often mentioned in the publications reviewed for this study and in the ERIC system are teaching

students how to find, understand, and retain the major ideas and supporting details in reading materials used; helping students master skills in locating, evaluating, and using information and making certain that materials are appropriate for the different reading levels within classes; helping students build their vocabularies and teaching them to use plans such as the SQ3R method; teaching word analysis; and showing students how to use different parts of the textbook such as the preface, summaries, graphic aids, author's organization and the index.[12] Biology teachers should emphasize the understanding and retention of ideas and science concepts encountered when reading science materials by setting definite purposes for reading text and supplementary biology materials; for example, to evaluate materials on a particular topic or issue, to determine the significance of a particular passage of printed material, or to answer specific questions.[13]

Other suggestions include taking time to help students acquire an understanding of biological concepts, concepts of time and space, the chronology of eras and events, the relationships of plants and animals, the relationships between past and present, and cause-effect relationships; providing differentiated reading materials and assignments when necessary, helping students gain knowledge and skills in the use of charts, tables, graphs, maps and other graphic presentations for help in acquiring an understanding of basic concepts and major topics; helping students learn to discriminate between fact and opinion, to draw

valid conclusions, and to make sound inferences and generalizations. Teachers can also show students how to weigh the accuracy of different statements and experiments, make sound comparisons and contrasts, and put a scientific idea in one's own words without changing the meaning of the printed material. Teachers can also train their students to deal with lengthy compound-complex sentences often found in biology texts whose paragraphs are packed with concepts.[14]

Much research shows that good readers are good thinkers. As biology teachers work to teach students to understand biology and to know and use the scientific method, it is extremely important for students to read effectively. Effective readers have many characteristics of productive scientists such as the following: curiosity and creativity, ability to foresee, keen observation, ability to arrange and classify, to infer and to think evaluatively or critically. Truly, there is a close relationship between being an effective reader and using the scientific method.[15]

## Interview and Questionnaire Analysis

The major concern of this study was to secure data from the 71 biology teachers through the use of questionnaires and interviews. During the course of the interviews the teachers were asked to complete a short questionnaire. A stamped, self-addressed envelope was provided for those who wanted to complete the questionnaire at home or later when they were alone in their school. Fifteen of the 71 preferred to do this. The analysis of data given below is based on the response of these experienced

teachers to two of the eleven questions on the questionnaire. The first of these two questions was, "Do you feel that it is the responsibility of the high school biology teacher to teach students special reading and study skills in your classroom if it is evident that they need help with such skills?" Sixty-two of the experienced teachers gave an unqualified yes to this question. Four said no, and five said yes, but put limitations to their responses which indicated some ambivalence on their part. In essence, they were concerned over how much time and effort they could give to study and reading skills since they had so much content to teach. Two expressed concerns about student performance on biology achievement tests if they devoted very much time to teaching reading and study skills. The author and the three reading specialists who helped analyze the data felt that these two teachers were very sincere in their reasoning but misinterpreted the role of a content teacher in the area of reading and study skills.

The second question was, "Would you please take a few minutes and state on the blank page attached to this questionnaire the most effective methods or procedures you believe that high school biology teachers can use to teach the special reading and study skills needed by students in their classes?" The teachers were asked to list at least five promising methods, but not to list over seven or eight. The ten approaches or procedures most often stated by these biology teachers are given below. The exact wording of each response was carefully studied, classified, and then summarized into a statement which would

convey the meaning of the various responses even though the verbatim wording of each teacher's statements could not be given here. Three reading specialists helped the author classify and summarize the responses. Number one was listed the greatest number of times; number two was the next most often stated and so on through number ten below.

The results were as follows:

1. In biology classes teach the special biology (science) vocabulary as students are given assignments in the text and other supplementary printed materials.

2. Give specific questions for which students are to know and be able to write specific answers. These should cover the major topics. Later use these for parts of study guides and use some or all on major tests. (The reading specialists stated that this was setting specific purposes for reading.)

3. Teach students to read and then state orally or in writing what they have read. (The reading specialists referred to this as recall or summarizing.)

4. Teach students to read and think as a scientist does in his work. (The reading specialists called this creative reading, evaluative reading or mental alertness when reading.)

5. Teach students to preview chapters in texts, supplementary materials or lab manual lessons, then read and study and review--in a deliberate way. (The reading specialists called this a variation of the Survey Q-3R Method.)

6. Teach students to read (look for) major ideas and supplementary and descriptive details.

7. Use supervised study in which students are reading, studying, working on homework or using supplementary materials on the subject. (This author considered this a very important recommendation even though only 19 teachers of the 71 worded this as supervised study.)

8. Teach students to think about how biology affects their health, world, present life and their future as they read the material. Try to get them to read related material in newspapers, magazines and other printed material. Teach them to think of the value, truth, worthwhileness and source of the materials they read.

9. Help students learn to recognize the organizational plans used by writers. (Simple to complex, comparison and contrast, relationships and common characteristics and cause-effect relationships.)

10. Teach students to use the special terminology used in answering oral and written questions and in writing short and lengthy papers. (Several teachers also mentioned investigative skills such as teaching categorizing, prediction and mental planning of writing exercises in which the science vocabulary would be used in a scientific way.)

## Conclusions and Recommendations

Recent literature on teaching reading and study skills needed in high school biology classes and the results of the 71 interviews in this study seem to verify several conclusions. High school biology teachers have responsibilities in the area of reading and study skills; special reading and study skills in high school biology classes must be an area of concern for teachers in this subject who are striving for effective teaching and learning.

The data secured from the interviews indicated that the most effective ways for helping students learn the special reading and study skills needed in high school biology classes were essentially the following: (1) help students set definite purposes for reading and studying textbook and other materials; (2) help students master special vocabulary, science terminology and concepts; (3) provide a variety of reading materials which are appropriate for biology classes and the students' reading levels; (4) teach students how to find and retain the main ideas of a selection and relevant details; (5) use supervised study and teach students how to use their textbooks and reference materials effectively; (6) help students learn to read science materials critically and evaluatively; (7) show students how to use pictorial and graphic aids and materials provided by the author; (8) use technology and media to reinforce learning, to promote retention, and to build concepts in biology; (9) teach students the skills needed in locating, using and evaluating information

and materials used to answer questions or to solve research problems in biology; and (10) encourage students to practice the scientific method in reading and study skills. Try to get the students to see that reading in this way can help them have a concrete basis for scientific, creative, conceptual thinking and learning.

It is the personal conclusion of this researcher that when high school biology teachers know and teach the special reading and study skills needed to master the textbook and other printed materials used by their students, they can teach more effectively and their students will learn more effectively. It is also his belief that more research and the application of research findings on this topic should be done in science classes in general and biology classes in particular.

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